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Quantitative Microbiological Survey in Hornsund, SW Spitsbergen. Reconaissance Study in Summer 1985

by

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Summary. Reconaissance microbiological survey was conducted in Hornsund in summer (June–July) 1985. The total numbers of bacteria in surface fjord waters ranged from 0.8 to 1.3×10^8 cells per liter. Basing on the above numbers the biomass of bacterioplankton was estimated to be 0.01 mg/l and 0.002 mg/l of bacterial carbon. The numbers of saprophytic bacteria was found to range from 0.15 to 63.0×10^5 cells/l.

The aim of the present study was a preliminary estimation of bacterioplankton biomass in Hornsund marine waters. This was a part of wide ecological investigations performed by Polish expeditions in coastal areas of South Spitsbergen [29]. Till now Svalbard coastal and fjord waters have not been an object of such study. Some data are available from another Arctic waters: the neighbouring Barents Sea [25, 4, 20] and Canadian Arctic seas [13, 19]. Marine bacteria from polar oceans have been investigated in Antarctic [15, 21, 14, 32, 10, 11, 12, 33].

The microbiological pattern of freshwater tundra ponds on West Spitsbergen was given by Fischer and Fischer [7].

Material and methods

Sampling was carried out from innermost fjord pool to outer fjord basin (Figure). That area was differentiated with regard to hydrology and sediment distribution [28, 22, 8].

Water samples were collected with steel one-liter Nansen bottles, ethanol-sterilized according to the method used by Kriss *et al.* [18]. Material was kept at 2° C of the *in situ* temperature until the assays could be initiated (within 2 h of collection), [9, 1, 20].

Saprophytic bacterial cells were determined by the growth on solid medium method. Zo Bell medium of pH 7.6 consisting of: Bacto-pepton, Bacto-agar, Bacto-beef extract, $FePO_4$ and marine water taken *in situ* was inoculated with 0.2-ml and 0.5-ml water samples, each three times. The samples were incubated at 9° C which was reported as optimal for growing of bacteria from polar seas [16]. The grown up colonies were counted after 5, 10, 15 and 20 days of incubation. Longer incubation did not result in increase of the number of colonies. The 20-day period was used as the basis for the general estimation of bacteria numbers. Results were expressed as number of saprophytic bacterial cells per liter of sea water.

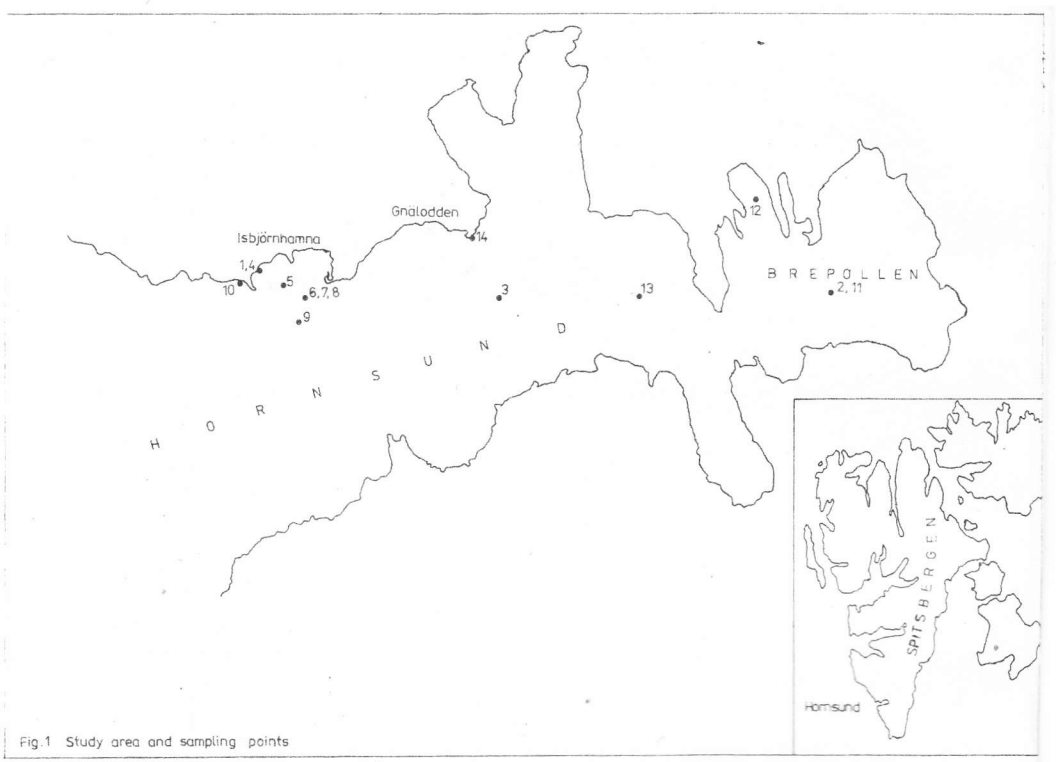

Fig.1 Study area and sampling points

Study area and sampling points

The total number of bacteria was determined by the method of direct microscopic count recommended by Erlich [5], Rodina [24]. Water samples of 10 ml, 20 ml and 50 ml were filtered through 0.22 μm Millipore membrane filters. The bacterial sediment was stained with 5% erytrosine solution in 5% phenol water. Results were expressed as number of bacterial cells per liter of marine water.

The size of bacterial cells was measured with an eyepiece micrometer.

Bacterioplankton biomass (BPB) was determined according to the following formula:

$$BPB = d \cdot V \cdot Tc$$

were: d – density of bacterial cell – 1.1 $g \cdot cm^{-3}$ (after [17]), V – cellular volume of planktonic marine bacteria – 0.09 μm^3 (after [6, 30, 2, 23)], Tc – total number of bacterial cells/1.

Bacterial carbon biomass was estimated from bacterial abundance assuming 20 fg C per cell. This assumption in based on a cellular volume for planktonic marine bacteria (sea above) and a biomass: biovolume conversion factor of 220 fg C per μm^3 [3].

Results and discussion

Saprophytic bacteria. The size of saprophytic cocci cells was 0.3 – 1.1 μm; the rods: length 0.9 – 1.8 μm; width 0.3 – 07 μm. Hence, average cellular volume for saprophytic bacterial cell was 0.18 μm^3. This is similar to value given by

TABLE

The results of growth on solid medium and direct counting of bacteria cells

No	Date (July 85)	Depth (m)	Number of bacteria cells in water samples on investigated stations				
			After incubation on solid medium (cells $\times 10^4$ l^{-1})				Direct counting (cells $\times 10^7$ l^{-1})
			5 days	10 days	15 days	20 days	
1	6	0	30	76	100	110	·
2	9x	0	—	6.5	7	7.5	·
3	9x	0	—	5	6	1	·
4	17x	0	9	15	17	19	·
5	17x	0	3.9	5	7.7	8.6	·
6	17x	0	7.7	14	16	21	·
7	17x	15	0.4	0.7	1.5	1.5	11
8	17x	40	0.5	0.9	2.4	2.4	·
9	20	0	19	40	69	75	13
10	20	0	13	29	33	34	8
11	21xx	0	183	270	364	400	·
12	21xx	0	218	398	510	523	·
13	21xx	0	205	425	560	590	·
14	21xx	0	230	450	600	630	·

— a lot of mineral suspension, x — surface wind ways, xx — sunny and silent weather

Dudarenko [4], Mishustina and Baturina [20]. The Gram negative rods constituted 90% of total saprophytic bacterial number. Gram positive cocci constituted 5% and Gram positive rods another 5%. The percentual of given morphological forms was similar to this estimated by Sieburth [26].

The diameter of colonies have been varying during 20 days incubation from 1 to 5 mm, mostly from 2 to 3 mm. The white and creamy coloured colonies were grown as first and constituted 75% of all colonies, 23% were yellow and 2% orange and red.

The numbers of saprophytic bacteria ranged from 0.15 to 63.0×10^5 cells/l in Hornsund (Table). Other authors report from 0.07 to 5.0×10^5 saprophytic bacterial cells/l from Barents Sea [20]. Zdanowski [32, 33] and Sieburn [26] found from 0.008 to 4.7×10^4 saprophytic bacterial cells/l in Antarctic. The above data suggest that coastal waters of Hornsund are richer 10 to 100 times in saprophytic bacteria number.

Strong differences were found between samples collected on the same sampling point in different weather conditions (Table, Figure) samples 1,4; 2,11.

Samples collected from three different depths: 0, 15, 40 m suggest the most

abundance of saprophytic bacteria in surface layer (Table). Other authors report rather weak correlation of bacterioplankton with depth within shelf waters [25, 32, 33, 13, 19].

Distance from the shore, position within the fjord were not clearly linked with abundance of saprophytic bacteria (Table, Figure).

Total number of bacteria. High concentration of mineral suspended matter in Hornsund ranging 30–60 mg/l [8] made the direct counting of bacterial cells impossible in most cases. Only three samples were succesfully counted. Total numbers of bacteria based on the direct counting ranged from 0.8 to 1.3×10^8 cells/l (Table). The density of Hornsund's bacterioplankton is comparable to summer data from: neighbouring Barents Sea ranging from 0.4 to 4.3×10^8 cells/l [25, 4, 20] and Arctic Canada coastal water ranging from 1 to 13×10^8 cells/l [13, 19]. Reports from Antarctic regions are also similar to our values and vary from 0.02 to 6.5×10^8 cells/l [15, 14, 10, 11, 12, 33].

The biomass of bacterioplankton calculated according to total numbers of bacteria was about 0.01 mg/l and bacterial carbon biomass was about 0.002 mg/l.

According to the present data the bacterioplankton in Hornsund ranged as much as about 1.1% of total planktonic biomass in summer 1985 [27, 31).

Our results confirm the opinion that polar marine biota are rich in bacteria cells regardless low temperatures [13, 19].

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Б. Зайончковска, М. Зайончковски, **Количественное микробиологическое обследование в Хорнсунд, Шпицберген. Предварительное исследование летом 1985**

Предварительные микробиологические исследования проводились летом1985 (июнь-июль) в Хорнсанд. Общее число бактерий на поверхности воды фиорда колебалось от 0,8 до $1{,}3 \times 10^8$ клеток на литр. Ха основании вышеуказанного числа биомасса бактериопланктона оценивалась на 0.01 мг на литр и 0,002 мг на литр бактериального углерода. Число сапрофитных бактерий колебалость от 0,15 до $63{,}0 \times 10^5$ клеток на литр.